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QUARTERLY REPORT - DIVISION OF FOREST INSECT RESEARCH 1/

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N. D. Wygant

Most serious is the continued increase in 1957 of insect-caused losses in New Mexico and Arizona (see sections by Yasinski and Pierce for details). Bark beetles killed 610 million board feet. In addition, extensive killing of pinyon in the woodland type, particularly in northern New Mexico, reached an all-time high. Up to 1957 the heavy mortality of ponderosa pine was largely limited to the marginal sites. In 1957 the heavy mortality extended into the better ponderosa pine sites. The effects of good preciptation in 1957 upon mortality trend will be determined by the 1958 surveys.

Most encouraging is the low activity of Engelmann spruce beetle in Colorado and the successful conclusion of all major control projects.

A hurricane struck sections of the spruce type on the Minturn District, White River National Forest in September. The District Ranger promptly surveyed the damage by helicopter and submitted a map that delineated the heavy spots. This is a highly commendable action which we hope becomes standard procedure for all District Rangers following abnormal winds.

White grubs caused serious injury to native grasses on 6,000 acres of rangeland in the Black Hills National Forest (see section by Ostmark). By coincidence or as a result of alerting range management people to the possibilities of range insect damage, more and more reports are being received.

The New Mexico-Arizona Pest Control Committee meeting in Albuquerque on October 11 was well attended. The group recommended two meetings each year, a spring meeting to cover research accomplishments and program and a fall meeting to cover control programs.

1/ This report is a composite of items submitted by the workers in Forest Insect Research without editing by the Director's office. In that manner, the report should not only serve its primary purpose of reporting results, but also provide a medium for communication and exchange of ideas with co-workers.

The test to protect ponderosa pine from bark beetle attack at Bandelier National Monument by application of 2 percent DDT emulsion gave positive results. Only 3 of the 745 treated trees became infected; 103 of the 286 check trees were killed (see section by Massey).

Meetings:

Attended annual meeting of Society of American Foresters in Syracuse, New York, November 10-13, and Western Forestry and Conservation Association, Seattle, Washington, December 10-13.

ALBUQUERQUE LABORATORY

C. L. Massey

Data obtained on the life history and habits of the Southwestern pine beetle during the 1957 field season was partially analyzed. In 1957 there were 3 generations of the insect at Bandelier National Monument in Northern New Mexico. Peak emergence period of the overwintering brood was during the last two weeks in May. The peak of emergence for the summer brood occurred the last two weeks in July. The fall brood started to emerge during the middle of September, however, emergence was not complete. A high percentage of the insects will overwinter as adults.

Trees were attacked by the beetle from the middle of April until the middle of September, however, a very heavy period of attack occurred during the last week in July and the first week in August.

Trees attacked by D. barberi were invariably initially top killed by Ips lecontei, the Arizona five-spined ips. From 15 to 25 feet of the upper portion of infested trees was killed by the Ips beetle.

Examination of 256 Ips lecontei from twelve pinyon pine selected at random throughout the infested area revealed that 56 percent were infested with a nematode, Aphelenchulus sp. Preliminary studies to determine the effect of the nematode on its host revealed that infested females laid an average of 16 eggs in a two-week period. Uninfested females laid an average of 32 eggs during the same period.

A pilot control test was carried out in 1957 at Bandelier National Monument in an effort to protect green trees from attack by the Southwestern pine beetle and the Arizona five-spined ips. During the project 745 trees were treated with a 2 percent emulsion of DDT. Treatment was accomplished by Park Service employees. Only 3 of the 745 treated trees were attacked, 103 of the check trees contained in the plot were killed by the top-bottom combination attack of both insects.

Attendance at Meetings

Oct. 11 -- Southwestern Forest Pest Study and Action Committee Meeting. Participation by all members at the Laboratory

November 13-14 - Supervisors-Research Center Meeting, Flagstaff, Ariz. Massey.

November 19 - Supervisors-Research Center Meeting, Tucson, Ariz. Massey.

December 6 - Society of American Foresters, Program on Forest Insects and Diseases. Participation by all members of the Laboratory.

F. M. Yasinski

Summary of Forest Insect Conditions, Arizona, New Mexico, and West Texas- 1957.

Information obtained from aerial, ground, and pine mortality plot surveys have been tabulated and analyzed. Epidemic areas infested in 1957 were 3,851,320 as compared to 1,564,600 in 1956. Volume of timber killed by bark beetles was placed at 616.5 million board feet.

The important forest insect outbreaks recorded in 1957 are summarized in Table 1.

Bark Beetles

In 1956 a complex of Dendroctonus and Ips species were associated in recently killed pine on 1,711,400 acres in Arizona and New Mexico. Field examinations revealed Ips species, usually Ips lecontei Sw., Arizona five-spined ips, killing the top portion and usually Dendroctonus barbaei Hopk., Southwestern pine beetle, killing in and killing the basal portion of the tree. These bark beetles were occasionally found in the infested trees: Dendroctonus ponderosae Hopk., a roundheaded pine beetle, Dendroctonus approximatus Hopk., Colorado pine beetle, and Ips ponderosae Sw., western six spined ips.

The Black Hills beetle and roundheaded pine beetle were epidemic in limited areas.

The Arizona five-spined ips was observed in dying pinyon pine throughout the region. Extensive areas of pinyon have suffered almost 100 percent mortality. It is presumed that below normal rainfall for the past decade has made conditions favorable for an increase of this beetle.

Fir and Spruce Beetles

The Douglas-fir beetle was epidemic throughout the entire range of Douglas-fir. Heavy counts in the infested trees in heavy, indicating little, if any, reduction in damage for 1958. Natural control factors are nil.

The outbreak of the fir engraver beetle that started in 1948 continues to devastate the white fir stand in the Sandia Mountains east of Albuquerque, New Mexico. Numerous predators have reared in the laboratory from infested bolts, but the surviving bark beetle brood was still heavy. Complete elimination of commercial white fir is expected in certain parts of the area.

Defoliators

Budworm defoliation of host type was variable in 1957. The Mescalero Indian Reservation infestation, which was never sprayed for control but lies adjacent to a sprayed area, is subsiding due to unknown natural factors. Budworm damage was noticeable in areas sprayed in 1955 in northern New Mexico. Defoliation continued on the North Rim of the Kaibab in Arizona, with a heavy moth flight reported in 1957. The Forest Service plans to treat the entire susceptible type, approximately 80 thousand acres in 1958.

Needle miner damage on ponderosa pine was recorded in two new localities, making a total of four areas where the insect is known to be active. No tree mortality has occurred to date. The needle miner was identified by Mr. Clarke of the Division of Insect Identification, ARS, as a species of Argyresthia. Specific determination could not be made.

An unidentified sawfly has defoliated approximately 600 acres of ponderosa pine south of Grants, New Mexico. Specific determination of the insect is pending.

A new heavy infestation of a tussock moth (probably Hemerocampa sp.) on white fir was observed in the vicinity of Pinal Mountain south of Globe, Arizona.

Appraisal Survey

Black Hills Beetle - This beetle is attacking trees over a widely scattered area on the Carson National Forest. A 100 percent aerial tree count of "Kaibab" was made in September. The survey recorded 450 red tops on 90,000 acres. The infested area was divided into several blocks using natural boundaries. Each block was ground checked to verify the presence of the beetle and to obtain a ratio between previous and current year attacks. Estimates made from the aerial and ground survey data indicate that from 500 to 750 trees were infested in 1957.

Oct. 14-Nov. 8 - Attendance at Station Training Program in Statistics.

Summary of Forest Insect Epidemics Recorded During the 1957 Survey in Arizona and New Mexico

Insect	Arizona		New Mexico		Total	
	Centers No.	Area Acres	Centers No.	Area Acres	Centers No.	Area Acres
Pine Bark Beetles						
Ips & Dendroctonus spp. 1/	92	549,280	121	1,162,120	213	1,711,400
Black Hills beetle	--	--	4	19,380	4	19,380
Roundheaded pine beetle	1	600	--	--	1	600
Arizona five-spined ips (pinyon pine)	1	3,840	--	--	1	3,840
Subtotal	94	553,720	125	1,181,500	219	1,735,220
Fir & Spruce Bark Beetles						
Douglas-fir beetle	37	68,590	97	752,610	134	821,200
Fir engraver beetle	--	--	1	7,880	1	7,880
Western balsam bark beetle	5	4,580	27	163,200	32	167,780
Engelmann spruce beetle	--	--	2	1,280	2	1,280
Subtotal	42	73,170	127	924,970	169	998,140
Defoliators						
Spruce budworm	3	74,030	13	80,920	16	154,950
Great Basin tent caterpillar	10	59,680	25	191,010	35	250,690
Aspen leaf roller	--	--	1	500	1	500
Needle miner (ponderosa pine)	1	250	8	110,820	9	111,070
Sawfly (ponderosa pine)	--	--	1	640	1	640
Tussock moth (white fir)	1	100	--	--	1	100
Subtotal	15	134,060	48	383,890	63	517,950
Total	151	760,950	300	2,490,360	451	3,251,310

1/ Arizona five-spined ips associated with southwestern pine beetle and occasionally one or both of these associated with roundheaded pine beetle, Colorado pine beetle and western six-spined ips.

Pine Mortality Plots

The two pine mortality plots at Bandelier National Monument were discarded because they have sustained epidemic insect-caused loss. The mortality study is based on endemic losses. The plots will still be useful for what information they may yield about epidemic insect outbreaks.

There were 32 trees killed by insects on 38 10-acre plots in 1956, compared to 19 trees killed in 1955. This amounted to 22.7 board feet per acre compared to 10.8 board feet per acre in 1955. On only 2 10-acre plots at Banderlier National Monument, there were 58 trees killed by insects in 1956.

The following table shows the lack of tree selection by the beetle at Banderlie (epidemic area) as compared to fairly definite selection on the other plots.

Insect Kill--1956

Arizona and New Mexico	Risk	Total Trees	Killed Trees	Percent of Group Killed
	4	138	4	2.9
	3	576	8	1.4
	2	3,013	14	0.5
	1	6,010	6	0.1
Bandelier	4	33	5	15.2
	3	39	9	23.1
	2	113	16	14.2
	1	210	28	13.3

Since the start of the mortality study in 1953, 116 out of the 196 dead trees were killed by bark beetles. The following table lists the insects and the percentage of the total insect-caused kill attributed to them.

Insect	Percent of total insect-caused mortality
Dendroctonus spp.	38.8
Dendroctonus convexifrons	36.2
Dendroctonus barberi	21.5
Ips spp.	2.6
Dendroctonus ponderosae	0.9
	100.0

To date the risk rating system shows the most promise for determining which trees are most susceptible to insect attack. The following table gives the results obtained from the application of this system.

Risk Rating---1953-1956

Risk	Number live & dead	Number dead	Percent of group killed	Mortality ratio	Percent Living stand	Percent dead stand
4	138	42	30.0	26.0	1	36
3	576	27	5.0	4.0	6	24
2	3,013	34	1.0	1.0	31	29
1	6,010	13	0.2	0.2	62	11
Total	9,737	116	1.2		100	100
			Cumulative			
4	138	42	30.0	26.0	1	36
4+3	714	69	9.7	8.6	7	60
4+3+2	3,727	103	2.8	2.3	38	89
Total	9,737	116	1.2		100	100

Risk 4 trees would isolate 36 percent of the dead in 1 percent of the stand, while the inclusion of risk 3 trees would isolate 60 percent of the loss in 7 percent of the stand.

Appraisal Survey

Tussock moth: The Pinal Peak-Ferndell area, Globe Ranger District, Tonto National Forest was appraised in December. There are approximately 40 acres of heavy and 60 acres of light to moderate defoliation of white fir, caused by a tussock moth (probably Hemerocampa spp.). All ages of white fir are infested with the dominate trees showing the most severe top killing. Egg masses are numerous with no evidence of natural control factors observed. Chemical control will be undertaken in June 1958.

Eggs brought into the laboratory have hatched and the larvae are now being reared for positive identification.

Nov. 18-22 - Attendance at Station Writing Seminar.

Reports: Tussock Moth Infestation, Tonto National Forest, Globe Ranger District, December, 1957.

FORT COLLINS LABORATORY

B. H. Wilford

A problem of serious perspective is facing the Forest Services' Bessey Nursery at Halsey, Nebraska. Juniper seedlings in particular are affected deleteriously, the cause of injury is unknown, but there appears to be a relationship with old hedgerows. Investigations of the soil regarding composition, inhabiting organisms, and applications of chemical fertilizers, insecticides, and fumigants, were begun.

The Fort Collins Laboratory was represented at the December program-discussion meetings called by the Fort Collins, Rapid City, Laramie, and Grand Junction Research Units.

Joseph L. Saunders, a third-year transfer student in entomology at CSU, very ably served as a part-time student assistant during the quarter. Saunders served as a summer assistant on surveys at the Albuquerque Laboratory the past season.

The three woodpeckers (our beloved feathered friends) known as the America, Alpine, and Alaska Three-toed Woodpeckers have been given the one common name of Northern Three-toed Woodpecker. This is in accordance with the fifth edition (1957) of the Check List of North American Birds published by the American Ornithologists' Union. However, when scientific names are used, the three subspecies of Picoides tridactylus (linnaeus) are spelled out.

R. H. Nagel

New bioassay methods for studies with systemics are developing well.

Investigations with systemic insecticides are being made with unlabeled chemicals. The preliminary screening of new compounds and dosage tolerances are performed on American elms. For those purposes, tests are restricted to medium-age trees heavily infested with the European elm scale. The scale, particularly the second-stage nymphs which overwinter on the bark and twigs, serves very well as a bioassay animal. Unfortunately, the studies on Engelmann spruce for phytotoxicity and translocation must be restricted to trees not infested with bark beetles; and there are no suitable sucking insects present on spruce to serve as an index to the translocation of toxic sap components.

The preliminary work with systemic insecticides in Engelmann spruce is predicted upon the supposition that nonphytotoxic amounts can be introduced into the sapstream to prevent development or to kill newly-hatched larvae of the Engelmann spruce beetle. Daphnids and brine shrimp were considered as possible test organisms until preliminary experiments showed that larvae of the spruce beetle would so serve.

Original attempts in 1955 and 1956 were designed to work out a procedure with several first instar larvae isolated with plugs of spruce phloem in small glass vials. While the method showed promise, and still does, there was a disturbing amount of variation in larval survival in the controls. This variation in survival undoubtedly can be greatly minimized with a more ideal technique in transferring the larvae unharmed from the brood phloem to the isolation vials.

During the 1957 season the exploratory search for a satisfactory larval bioassay method was devoted to efforts to induce artificial infestations directly into the phloem of the experimental trees. The infestations followed by a few days the basal girdling of the trees under treatment. The girdling was performed approximately a week after the application of the systemic insecticides, and from 1 to 7 days before artificial infestation. The depth of the girdles varied from 0.5 to 2 inches into the xylem, and were intended to stop or to reduce pitch flow into the artificially infested phloem.

One method of inducing infestation was to confine 25 brood adults over a 1 x 2 foot section of the bole 16 feet above the ground. Each group of adults included three pairs that were excavated from egg galleries in a newly-infested trap tree some distance away. The other method involved the establishment of spot infestations with 10 to 20 eggs transferred in more or less undisturbed condition by removing a small wall-section of the egg gallery. This piece of tissue was inserted in a niche grooved into the phloem under a two-inch flap of bark carefully pried from the cambium with a knife. The flap was immediately pressed into position with a few nails and the knife slits sealed with asphalt wound dressing.

Concluding results of systemic chemical applications to spruce in 1957 are pending. The various experimental applications during the 1957 season were described in the report for the previous quarter. During October the final examinations for phytotoxicity were made for the season. No injury was observed. Conclusions on translocation within the trees had to be deferred until after another examination in the spring. Of the eggs laid by the caged adults, only a small portion had hatched at the time of fall examination. That situation raised the question as to whether the unhatched eggs were injured by toxic substances in the phloem, or whether embryonic development was prolonged by the unusually cold growing season.

In the case of the spot infestations, more of the eggs were hatched, probably because they could have been much older at the time of transfer. In a few control trees the larvae were relatively large.

With both methods, pitching-out was more pronounced than expected considering the girdling precautions used. The excessive pitch flow apparently indicated that girdling near the base does not appreciably reduce pitch flow at the infestation sites 3 and 14 feet above the kerf, or else the time period between girdling and infestation must be increased.

Systemics applied as soil drenches to elm apparently need to be used early in the growing season.

Soil drench applications with systemic insecticides to elm were also reviewed in the previous report. According to scale survival counts in November, Thimet, Phosdrin, and dimefox (Hanane) applied in late July 1957 were ineffective in elms growing on moist sites. It is believed that late applications should not be expected to yield positive results. Most favorable conditions for chemical absorption occur during the peak of plant physiological activity. For elms in the Fort Collins area this occurs during late May. The applications should be made a few weeks before this peak is reached.

Elms implanted with dimefox show insecticidal action for two seasons.

According to recently completed scale survival counts, elms implanted with dimefox in April 1956 were toxic to the European elm scale during 1957. Per sample unit at the 1 milliliter dose, the average scale survival in 1956 was 1, and for the controls, 97; during 1957 the survival was 0.5, and 6.4, respectively.

Meetings

Entomology Society of American, December 1-5. Presented a summary of the studies with systemic insecticides in American elm.

CSU Chapter Xi Sigma Pi, October 21. Described some uses of radio-isotopes in biology.

Biogeographic Seminar session on CSU campus, December 6. Discussed local dispersion of the Engelmann spruce beetle.

Publication:

Nagel, McComb, and Knight. 1957. Trap Tree Method for Controlling the Engelmann Spruce Beetle in Colorado. Jour. For. 55: 894-898.

F. B. Knight

The periodicity of attack by Engelmann spruce beetle in 1957 was studied in 5 1-acre plots and in trap trees on Owl Mountain.

The 5 plots were cruised 4 times at 2-week intervals. The peak attack period occurred in the last half of July. Some trees were newly infested as late as mid-August. This attack period was approximately 1 month later than in 1956.

Each trap tree was quickly saturated with attacking adult beetles after the initial attack. The trees had been felled in October 1956. The first attacks occurred about the second week in July; by the fourth week the maximum number of adults had been absorbed. The earliest attacks by Ips pilifrons

were made in mid-July 1957, on the top surfaces of the traps.

Final figures on emergency of spruce beetles for hibernation were obtained from cages installed on infested standing trees attacked in 1955.

These figures show that only a small percentage emerged in 1956 to hibernate in the bases; the majority remained along the boles of the trees.

Location	Cages	Beetle Emergence Fall		Beetle Emergence Spring	
	number	Peak number		Peak number	
Owl Mountain	20	48	mid-Sept.	918	mid-July
Dolores Peak	8	607	late-Sept.	3,926	early July

The reason for the light total emergence at Owl Mountain is the type of study. This is an endemic area where studies of endemic conditions are in progress. The trees contained only light strip-infestations; but the figures show that the same type of hibernation occurred at the two locations.

The 1957 fall emergence at Dolores Peak was not large but reached its peak in late September when 158 beetles were collected from the 10 cages. On Owl Mountain, however, no beetles emerged from 20 cages on standing trees nor from 20 cages on trap trees. All 40 of these trees were infested in 1956. Sample checks under the bark revealed that practically all of the progeny was still in the late larval stages in mid-October 1957. This slow development may have been a result of the wet cold season on Owl Mountain during 1957.

Egg production by spruce beetles was recorded only at Owl Mountain (Routt National Forest) during 1957.

The average was 10 eggs per inch of gallery which is about the same as recorded at the same location in 1956. This is considerably below the average production during epidemics.

Many insects associated with the spruce beetle were collected from the cages in the endemic study area on Owl Mountain.

The most common among them was the Scolytid Scierus annectens which was collected from most of the cages. Others collected in large numbers were: Polygraphus rufipennis, Dryocoetes sp., Trypodendron sp., and Ips pilifrons; all are Scolytids. The following species and groups were quite commonly found: Rhizophagous dimidiatus, Ips swaini, Coeloides dendroctoni, and Clerids, Staphlinids, and Pselaphids. Many other species were rarely collected.

Additional data regarding parasites and predators of the spruce beetle were collected.

Predation by staphlinid larvae on the Engelmann spruce beetle was confirmed in three instances where larvae were observed feeding on callow adults of the beetle.

Twelve trees classified visually as having been fed on heavily by woodpeckers were felled. The effect of woodpeckers on the population was slight in the lower 5 feet of the boles. From 5 feet to the upper height of infestation, the effectiveness was high. Population survival above 5 feet was in all cases smaller than the number of beetles originally attacking the tree.

Black Hills beetle population counts were made at 3 locations during the year.

In 14 locations sampled in the three degrees of infestation since the study was initiated and up to 1957, the number of beetles surviving as measured just before emergence has averaged as follows:

7 areas of decreasing infestation	5.6 per sq. ft.
4 areas of static infestation	25.1 per sq. ft.
3 areas of increasing infestation	55.6 per sq. ft.

Surviving beetles per square foot averaged 26.5 and 23.4 in two static infestations and 38.4 in one increasing infestation sampled in 1957. Two of the infestations were sampled in the fall of 1957 and will be resampled in April and July of 1958.

The Black Hills beetle adults emerged extremely late on the Grand-Mesa Uncompahgre National Forest during 1957.

The earliest emerging beetles were collected in late August. The peak emergence occurred in mid-September. The first newly-attacked trees were found in mid-September. The roundheaded pine beetle, which is associated with the Black Hills beetle in the Uncompahgre infestation, began emergence in late September and reached a peak during early October. Many roundheaded pine beetles failed to emerge before cold weather occurred. The most common associates found were Hylastes sp. Pityopthorus sp. and Clerids.

Meetings

Attended the 5th Annual Meeting of the Entomological Society of America at Memphis, Tennessee, from December 2 to 5, 1957. Presented a paper entitled "Effects of Woodpeckers on Populations of the Engelmann Spruce Beetle".

H. E. Ostmark

Mountain pine beetle in the Absaroka Wilderness Area. On October 1-2, 1957, a mountain pine beetle, Dendroctonus monticolae Hopk., infestation in the Absaroka Wilderness Area, Shoshone National Forest, was inspected. There are approximately 1,200 infested trees on 2,500 acres. The area is 22 miles from the nearest road. When examined, eggs and larvae were present in average numbers. A re-examination will be made in 1958.

June beetle grubs in Black Hills rangeland.

An inspection of a cattle allotment on the Bear Mountain District showed heavy grass killing by grubs of a June beetle, Phyllophaga sp. The

grubs appear to prefer prairie dropseed, Sporobolus heterolepis, a grass high in forage value. Areas where this species had been killed by root feeding grubs had been invaded by grasses and weeds of low palatibility. This reduced the carrying capacity of the range from 2 acres per cow month to 10-12 acres per cow month. Severe wind erosion in patches was occurring where the dropseed had been killed. The Forest plans to control the grubs with chlordane.

Engelmann spruce weevil in blue spruce.

A weevil, probably Pissodes engelmanni Hopk., was found mining the terminal twigs of blue spruce on the Buckhorn District of the Roosevelt National Forest. When the area was inspected in late November, no live insects were found. There were, however, numbers of dead adults and pupae in the terminals. The adults will be sent to Washington for definite determination.

Great Basin tent caterpillar egg-mass survey.

An egg-mass survey to determine the trend of Great Basin tent caterpillar, Malacosoma fragile (Stretch), populations was made in late October. Infested aspen were sampled on the San Isabel, Rio Grande, and San Juan National Forests. Special attention was paid to the 1,700 acres in the Cucharas Camps area on the San Isabel National Forest. These acres were sprayed in early summer with DDT by airplane. Fortunately, a natural virus disease reduced caterpillar populations in surrounding areas so there was little invasion of moths into the treated block during the flight and oviposition period.

Elsewhere, the caterpillar damage generally declined. An exception was the Conejos District of the Rio Grande National Forest where the egg-mass counts remained very high.

Manuscripts

Landgraf, A. E. and Ostmark, H. E. Forest Insect Conditions in the Central Rocky Mountains - 1957.

Meetings

A technical writing seminar given by the Rocky Mountain Station was attended by H. E. Ostmark from November 18-22, 1957. Station editor Elmer Shaw directed the course which covered several phases of letter writing, report writing, and grammar.

A. E. Landgraf

Forest insect aerial surveys.

Analysis of aerial survey data has been completed. A summary of infestations recorded during the 1957 aerial survey is as follows:

Insect	Infested acres
Bark beetles:	
Engelmann spruce beetle	2,200
Black Hills beetle	56,910
Douglas-fir beetle	32,860
Mountain pine beetle	12,780
Western balsam bark beetle and fir engraver beetle	64,050
Defoliators:	
Spruce budworm	89,500
Great Basin tent caterpillar	132,310
Large aspen tortrix	81,370
Needle miner	15,590

The Engelmann spruce beetle is endemic throughout the Region. Ground inspection and appraisal surveys are still required to determine the complete picture of spruce beetle conditions.

Black Hills beetle activity was found to be increasing throughout the ponderosa pine type on the front range mountains of Colorado and in the Black Hills National Forest in South Dakota. In general these infestations are in small groups. Elsewhere in the Region there has been a decline in Black Hills beetle activity through control efforts by land-managing agencies.

Increasing infestations of the Douglas-fir beetle were found on the Grand Mesa-Uncompahgre, San Juan, and San Isabel National Forests. Ground inspections and appraisal surveys on the Pike and Rio Grande National Forests show Douglas-fir beetle activity to be declining.

The mountain pine beetle continues its destruction of lodgepole and limber pine type on the northern half of the Shoshone National Forest in Wyoming. Epidemic infestations occur on the Wiggins Fork drainage north of Dubois, in the Belknap Creek area southwest of Cody, and along the North Fork of the Shoshone River.

Fir engraver beetle infestations declined in size and intensity in the Flat Top Wilderness area on the White River National Forest. This decline is due to the paucity of host material. Fir engraver activity throughout the spruce-fir type in other forest areas is about the same as it was in 1956. These engravers continue to take a heavy toll of subalpine fir in Colorado and Wyoming.